AQA

Please write clearly in block capitals.

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Forename(s) _____

Candidate signature _____
I declare this is my own work.

GCSE
COMBINED SCIENCE: SYNERGY

H

Higher Tier Paper 1 Life and Environmental Sciences

Friday 10 May 2024 Morning Time allowed: 1 hour 45 minutes

Materials
For this paper you must have:
- a ruler
- a protractor
- a scientific calculator
- the periodic table (enclosed)
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

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0 1 Bacteria can cause disease.

Bacterial cells do **not** have a nucleus.

0 1 . 1 Which term describes bacterial cells?

[1 mark]

Tick (✓) **one** box.

Eukaryotic ☐

Fungal ☐

Prokaryotic ☐

0 1 . 2 Bacterial cells have no nucleus and are smaller than animal cells.

Give **one other** difference between bacterial cells and animal cells.

[1 mark]

_____

_____

Do not write outside the box

Escherichia coli (*E. coli*) is a type of bacterium.

E. coli causes symptoms of food poisoning.

0 1 . 3 Water companies sterilise rain water to produce drinking water.

The drinking water is then transported to homes in underground pipes.

Flooding can cause contamination of the drinking water by *E. coli.*

Suggest how people should treat drinking water **at home** if there is a risk of *E. coli* contamination.

[1 mark]

_____

_____

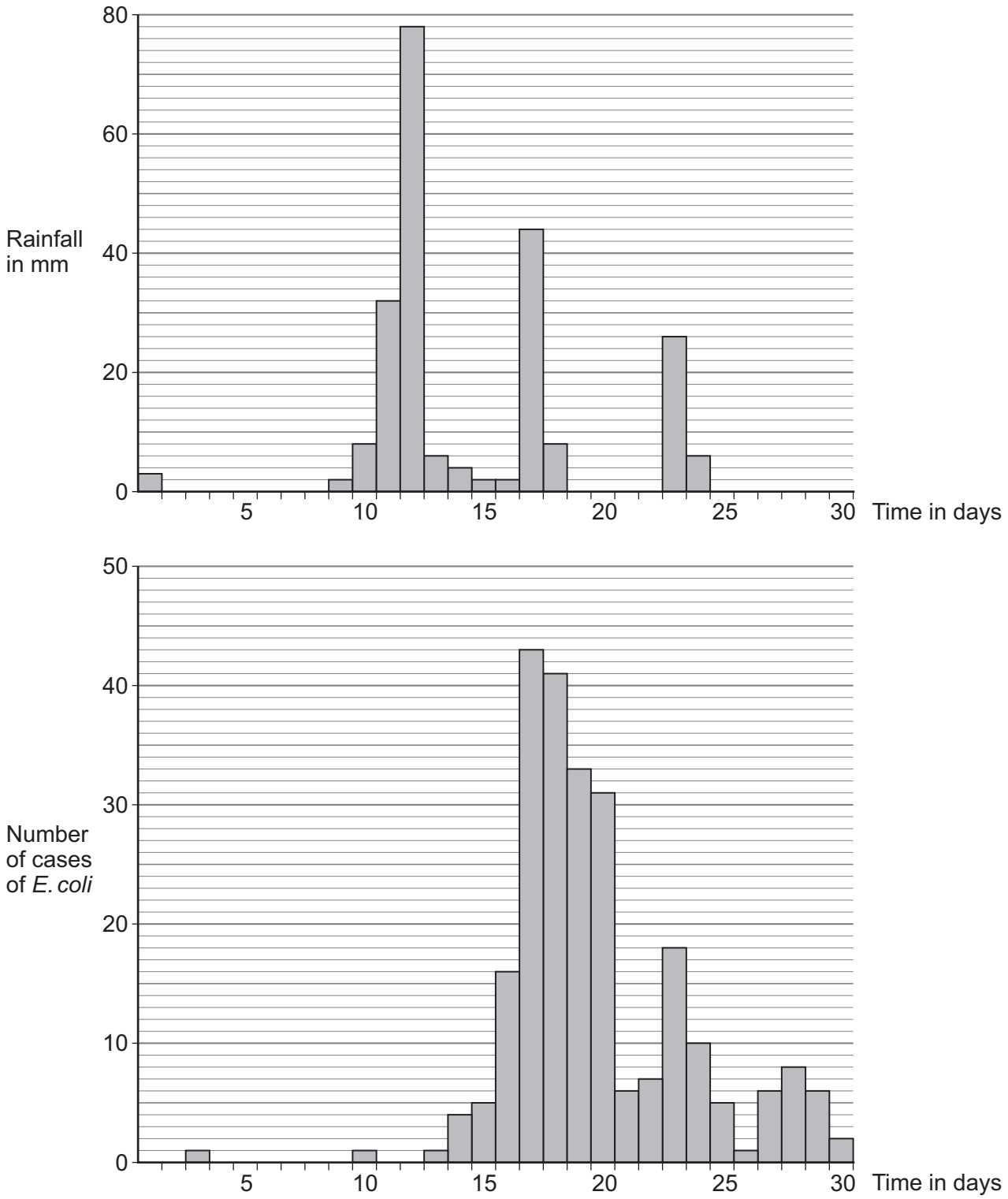
Question 1 continues on the next page

Do not write outside the box

Figure 1 shows two graphs:

- The rainfall in one town in one month.
- The number of cases of *E. coli* in the town in the same month.

Figure 1



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0 1 . 4 The **rainfall** on day 12 was greater than on day 10.

Calculate how many times greater.

[3 marks]

Number of times greater = _____

0 1 . 5 Symptoms of *E. coli* infection usually occur 5 days after infection.

A scientist stated:

'Increased rainfall causes an increase in the number of cases of *E. coli*.'

Describe **one** piece of evidence from **Figure 1** that supports the scientist's statement.

[1 mark]

Question 1 continues on the next page

Do not write outside the box

0 1 . 6 Why might the number of cases of *E. coli* infection increase in the future?

[1 mark]

Tick (✓) **one** box.

Climate change is causing loss of habitats for wildlife. ☐

Climate change is causing more extreme rainfall. ☐

Climate change is causing sea-levels to be lower. ☐

Climate change is caused by an increase in the concentration of greenhouse gases in the atmosphere.

Carbon dioxide is a greenhouse gas.

0 1 . 7 Name **two** other greenhouse gases.

Do **not** refer to carbon dioxide in your answer.

[2 marks]

1 _____

2 _____

0 1 . 8 Describe **one** way the rate of increase in carbon dioxide concentration in the atmosphere could be reduced.

[1 mark]

_____

_____

11

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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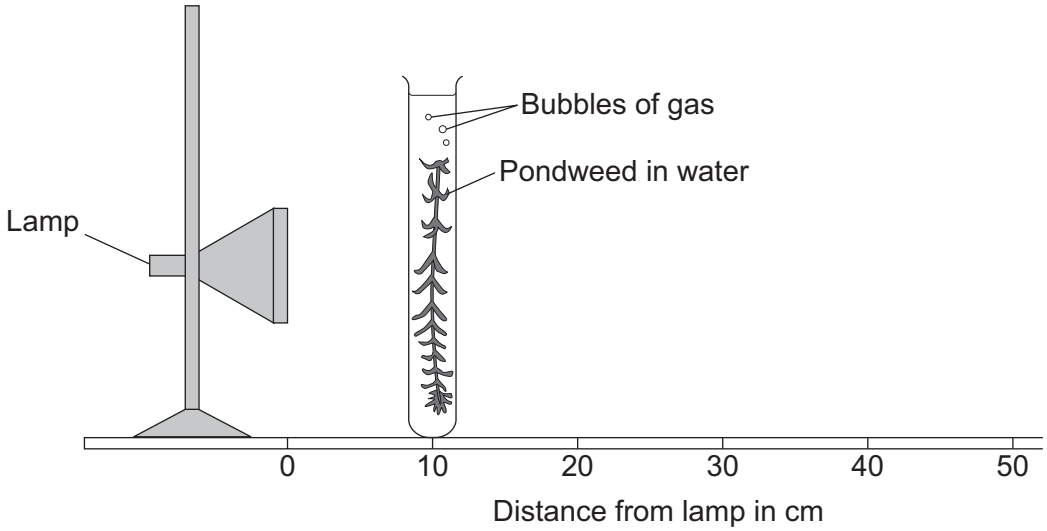
0 2 **Figure 2** shows equipment used to investigate how light intensity affects photosynthesis.

Figure 2



The light intensity can be changed by moving the pondweed to different distances from the lamp.

Describe a method to investigate the effect of light intensity on the rate of photosynthesis in pondweed.

[6 marks]

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6

Turn over for the next question

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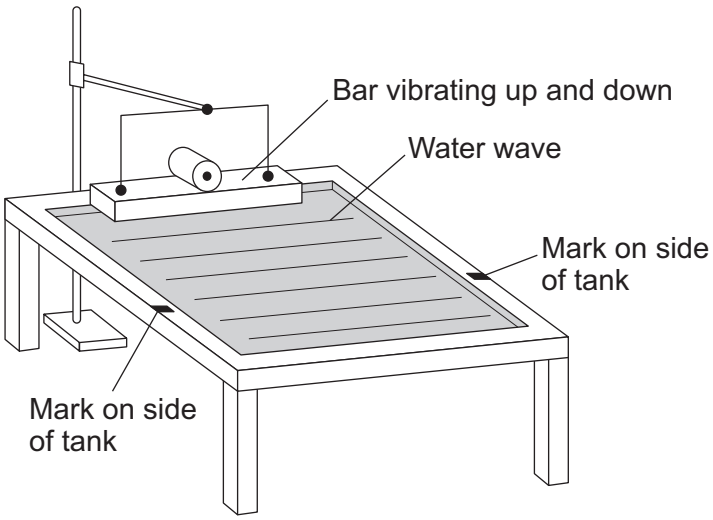
0 3 **Figure 3** shows a ripple tank used to investigate the behaviour of water waves.

Figure 3



0 3 . 1 Water waves are transverse waves.

Complete the sentence.

Choose the answer from the box.

[1 mark]

parallel	**perpendicular**	**the same**

In transverse waves, the direction of oscillation and the direction of energy transfer are _____.

Do not write outside the box

0 3 . 2 Describe a method a student could use to determine the frequency of the water waves.

[4 marks]

Question 3 continues on the next page

Do not write outside the box

Use the Physics Equations Sheet to answer Questions **03.3** and **03.4**.

0 3 . 3 Which equation links frequency (f), wavelength (λ) and wave speed (v)?

[1 mark]

Tick (✓) **one** box.

$v = \frac{f}{\lambda}$ ☐

$v = f\lambda$ ☐

$v = f^2\lambda$ ☐

Do not write outside the box

0 3 . 4 **Figure 4** shows the water waves in the ripple tank when viewed from above.

Figure 4

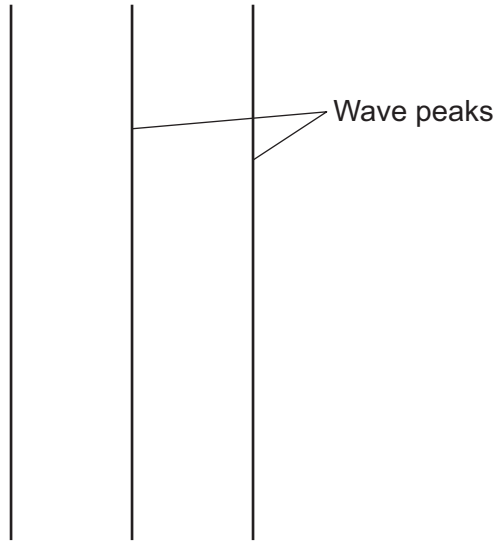


Figure 4 has been drawn to actual size.

The water waves have a frequency of 2.5 Hz.

Calculate the wave speed of the waves in **Figure 4**.

You should take measurements from **Figure 4**.

[4 marks]

_____

_____

_____

_____

_____

Wave speed = _____ m/s

10

Turn over ▶

Do not write outside the box

0 4 The symptoms of a measles infection are:

- a fever
- a red skin rash.

0 4 . 1 Why can measles **not** be treated with antibiotics?

[1 mark]

_____

_____

0 4 . 2 Describe **two** ways the human body defends against the **entry** of the measles pathogen into the lungs.

[2 marks]

1 _____

_____

2 _____

_____

0 4 . 3 A person is given a measles vaccination by injection.

There is a small amount of bleeding from the wound.

What is the role of platelets after the person receives the injection?

[1 mark]

Tick (✓) **one** box.

To begin phagocytosis ☐

To cause the blood to clot ☐

To release antitoxins ☐

Do not write outside the box

0 4 . 4 How do white blood cells respond to a vaccination against measles?

[1 mark]

In the UK, most people have been vaccinated against measles.

0 4 . 5 In a sample population, the ratio of vaccinated people to unvaccinated people is 594 000 : 99 000

Give 594 000 : 99 000 as the simplest whole number ratio.

[1 mark]

Simplest whole number ratio = _____ : _____

0 4 . 6 Explain why it is important that the ratio of vaccinated people to unvaccinated people is high.

[2 marks]

8

Do not write outside the box

0 5 This question is about the nervous system.

A person steps on a sharp object.

The person immediately moves their foot away from the object.

The response is a pain withdrawal reflex.

0 5 . 1 Describe **two** ways that a reflex action is different from a conscious action.

[1 mark]

1 _____

_____

2 _____

_____

Do not write outside the box

0 5 . 2 Describe how the nervous system causes the reflex action after stepping on the sharp object.

[6 marks]

Question 5 continues on the next page

Do not write outside the box

Table 1 shows information about two types of reaction time.

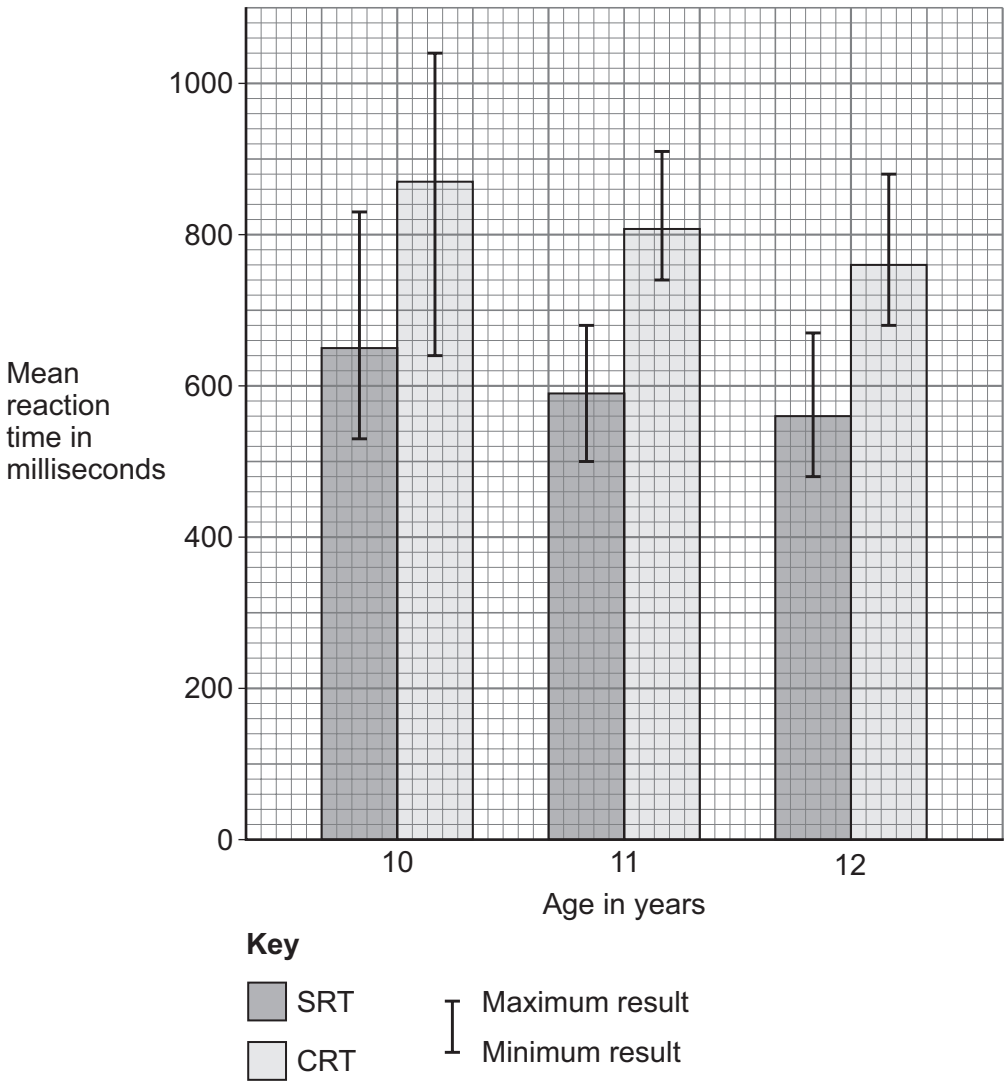
Table 1

	Description	Example
Simple reaction time (SRT)	Time taken to respond to a predictable event.	A runner starting a race when there is a sound signal.
Choice reaction time (CRT)	Time taken to respond when a decision about how to respond is needed.	Deciding which team member to throw a ball to.

Scientists investigated how the age of students affects SRT and CRT.

Figure 5 shows the results.

Figure 5



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0 5 . 3 In the investigation the sex, physical health and mental health of the students were control variables.

Suggest **one other** control variable the scientists should have used.

[1 mark]

_____

_____

0 5 . 4 Determine the size of the range of CRT for students aged 11 years.

Give your answer in seconds.

[3 marks]

_____

_____

_____

_____

Size of range = _____ seconds

0 5 . 5 A student stated:

'The age of students affects their reaction time.'

Evaluate the student's statement.

Use **Figure 5**.

[2 marks]

_____

_____

_____

_____

_____

13

Turn over ▶

Do not write outside the box

0 6 The atmosphere of the Earth has changed since the Earth formed.

0 6 . 1 What was the source of nitrogen in the Earth's early atmosphere?

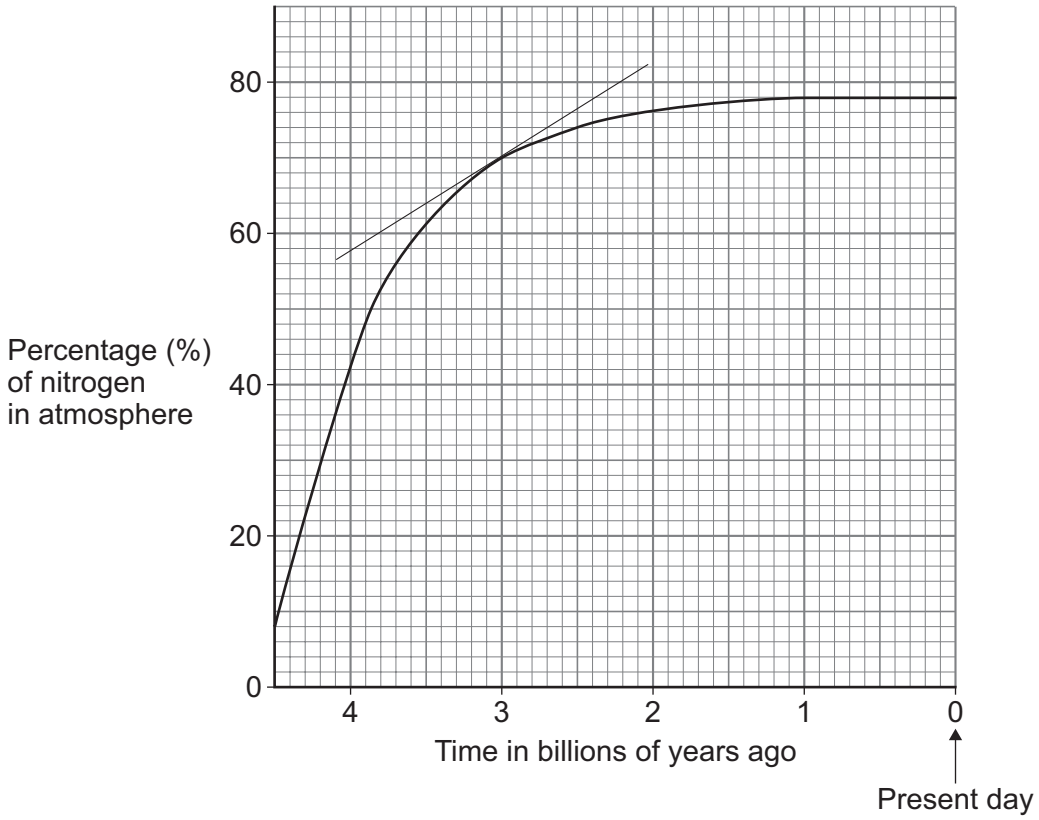
[1 mark]

_____

_____

0 6 . 2 **Figure 6** shows the change in the percentage of nitrogen in the Earth's atmosphere during the last 4.5 billion years.

Figure 6



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The graph shows a tangent drawn at 3.0 billion years ago.

Determine the rate of change in the percentage of nitrogen in the atmosphere 3.0 billion years ago.

Give your answer to 2 significant figures.

[4 marks]

Rate of change (2 significant figures) = _____ % per billion years

Question 6 continues on the next page

Do not write outside the box

0 6 . 3 Why did the percentage of **carbon dioxide** in the Earth's early atmosphere change when the oceans formed?

[1 mark]

0 6 . 4 A student stated:

'The evolution of algae was essential for the evolution of animals.'

Explain why the student's statement is correct.

[4 marks]

10

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Turn over for the next question

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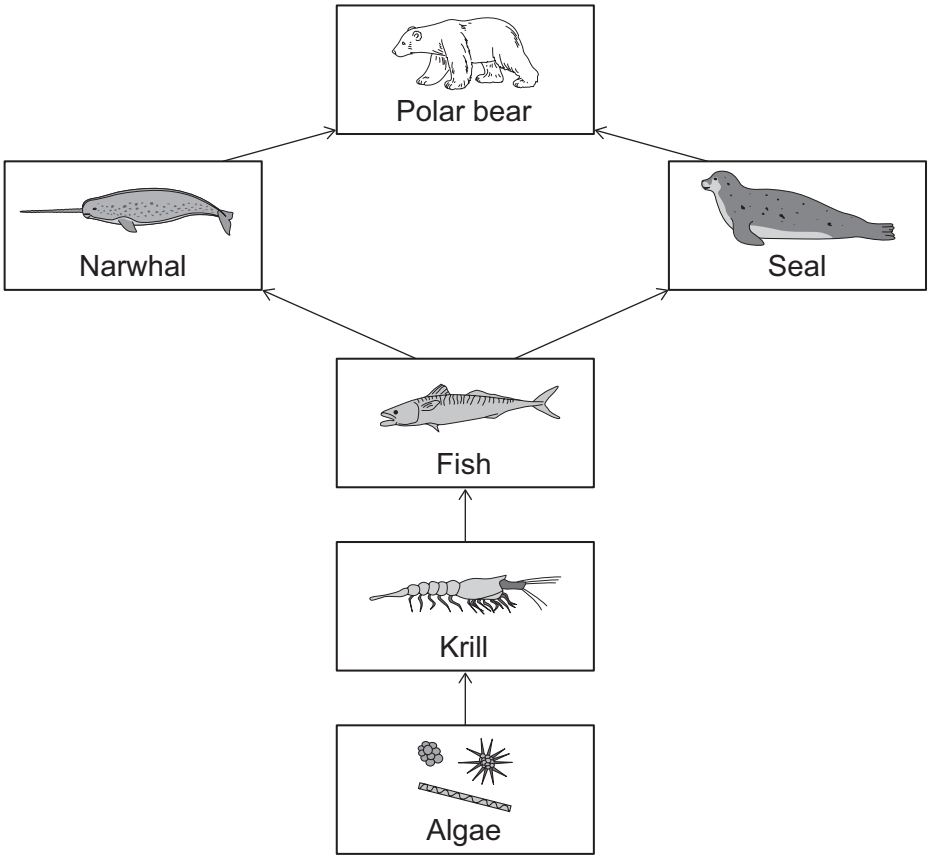
0 7 **Figure 7** shows part of a food web from one ecosystem.

Figure 7



0 7 . 1 Define the term ‘ecosystem’.

[1 mark]

_____

_____

_____

Do not write outside the box

0 7 . 2 Describe the difference between a population and a community in one habitat.

[1 mark]

0 7 . 3 Humans kill narwhals for meat and skin.

Killing more narwhals can cause the number of seals to increase or decrease.

Explain why killing more narwhals can have two different effects on the number of seals.

[2 marks]

Question 7 continues on the next page

Do not write outside the box

0 7 . 4 The algae in **Figure 7** store a mass of 68 arbitrary units of carbon in 1 year.

8.4% of the carbon in each stage of the food web is passed to the next stage.

Calculate the mass of carbon stored in tertiary consumers in 1 year.

[3 marks]

_____

_____

_____

_____

_____

_____

Mass of carbon = _____ arbitrary units

0 7 . 5 Mineral ions are at:

- a low concentration in sea water
- a high concentration in algae.

Name the process algae use to absorb mineral ions from sea water.

[1 mark]

_____

Do not write outside the box

0 7 . 6 Algae and plants are producers.

Explain how **not** having enough magnesium ions and nitrate ions can limit the mass of carbon stored in producers.

[5 marks]

13

Turn over for the next question

Do not write outside the box

0 8 This question is about plant tissues.

0 8 . 1 Plant meristem tissue is found in the growing tips of shoots and roots.

Name **two** processes in plants that only occur in meristem tissue.

[2 marks]

1 _____

2 _____

An acorn is a nut that contains the seed of an oak tree.

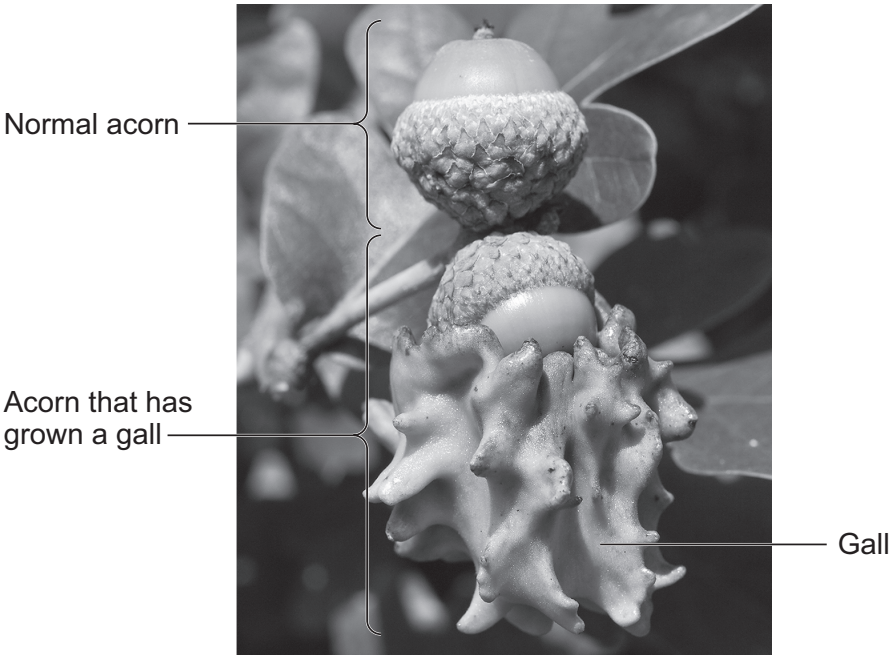
When one type of insect lays an egg in an acorn, the acorn grows abnormally.

The abnormal growth is called a gall.

An insect embryo grows inside the gall.

Figure 8 shows a normal acorn and an acorn that has grown a gall.

Figure 8



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0 8 . 2 The seed in an acorn forms from one original cell with two sets of oak tree chromosomes.

The original cell in each seed was produced by sexual reproduction.

The gall has cells that contain two sets of oak tree chromosomes.

Compare the process that produced the original cell in each seed with the process that produced cells in the gall.

[3 marks]

Question 8 continues on the next page

Do not write outside the box

The insect embryo inside the acorn:

- causes the growth of the gall
- uses nutrients from the gall to grow
- causes lignin to form around the outside of the gall.

The lignin around the gall protects the acorn from being eaten by herbivores.

0 8 . 3 Which other structure in the oak tree contains lignin?

[1 mark]

Tick (✓) **one** box.

Phloem ☐

Root hair cells ☐

Xylem ☐

0 8 . 4 Many years ago, a mutation of an insect embryo led to the embryo causing lignin production in an acorn.

Explain how the mutation could have produced a population of insects that all cause lignin production.

[3 marks]

_____

_____

_____

_____

_____

_____

9

Do not write outside the box

0 9 This question is about atoms.

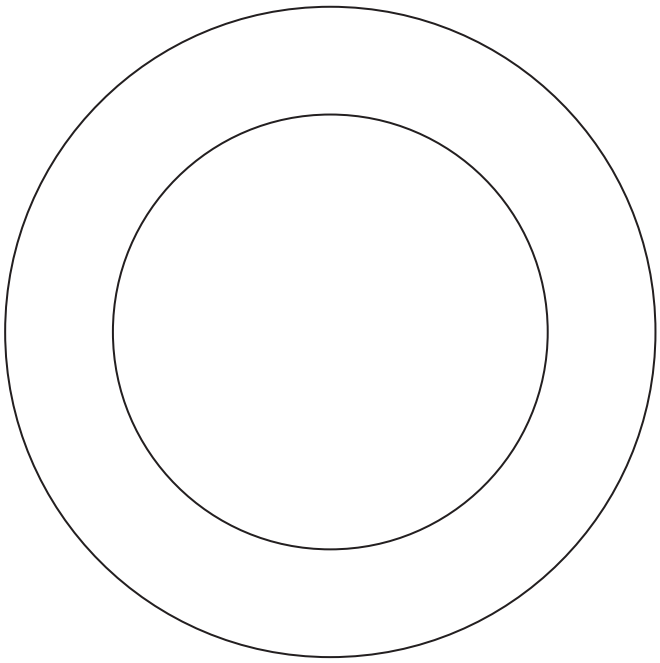
0 9 . 1 An atom of lithium can be represented as $^{7}_{3}Li$

Complete **Figure 9** to represent this atom of lithium.

You should draw and label the sub-atomic particles.

[3 marks]

Figure 9



Question 9 continues on the next page

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0 9 . 2 Scientific models of the atom have included:

- the Dalton atom
- the plum pudding model
- the nuclear atom.

Explain why the model of the atom has changed over time.

You should refer to these three models.

[4 marks]

Do not write outside the box

0 9 . 3 An atom has a radius of 0.348 nm.

Calculate the radius of the atom in metres.

Give your answer in standard form.

[2 marks]

Radius (in standard form) = _____ m

0 9 . 4 In chemistry, a pure substance is a single element or compound.

Describe how measurements taken during a change of state can show if a substance is pure.

[1 mark]

10

Turn over for the next question

Do not write outside the box

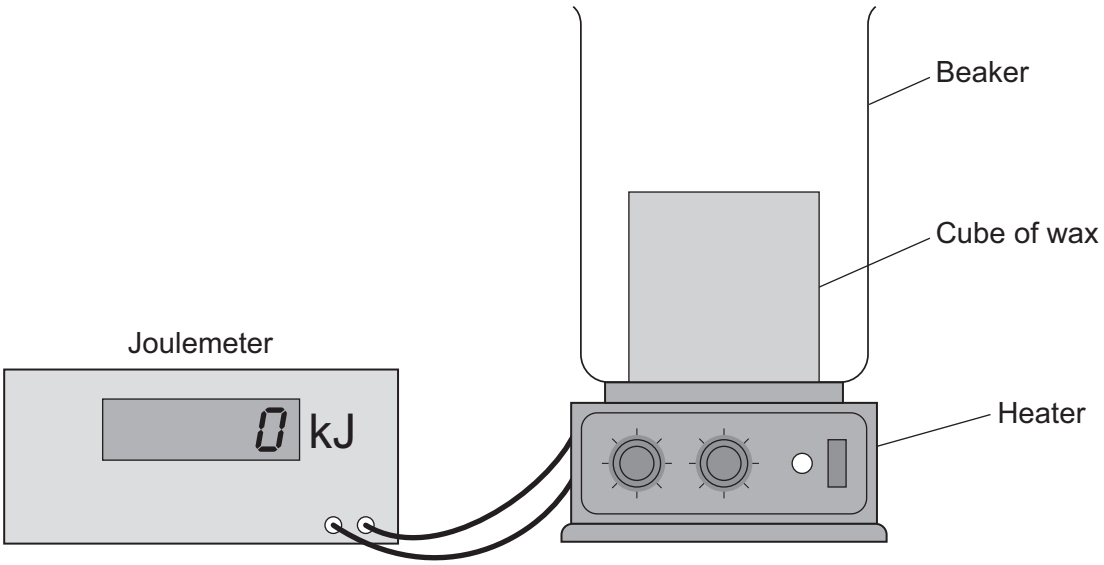
1 0 A student investigated the heating of some wax.

This is the method used.

1. Put a cube of wax in a beaker.
2. Place the beaker on a heater connected to a joulemeter.
3. Turn on the heater.
4. When the wax begins to melt, turn on the joulemeter.
5. When all the wax has melted, record the reading shown on the joulemeter.

Figure 10 shows the arrangement.

Figure 10



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1 0 . 1 The student made these measurements:

mass of the cube of wax = 0.15 kg

energy transferred to melt the wax = 33 kJ

Calculate the specific latent heat of fusion of wax using the student's measurements.

Use the Physics Equations Sheet.

[4 marks]

Specific latent heat of fusion of wax = _____ J/kg

1 0 . 2 The student's value for specific latent heat of fusion is **not** accurate because some energy was dissipated to the surroundings.

Explain how the dissipation of energy affected the student's calculated value.

[2 marks]

Question 10 continues on the next page

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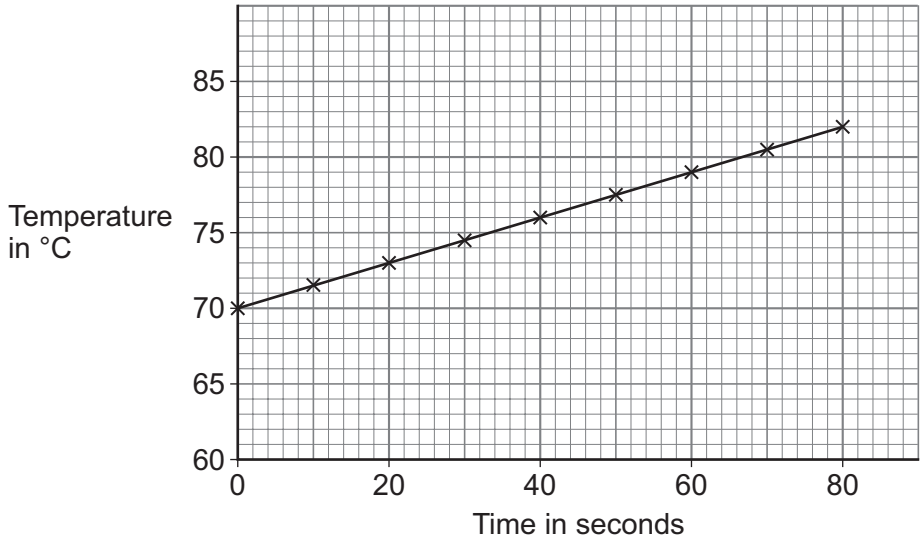
1 0 . 3 The student continued to heat the wax after it had melted.

The student measured the temperature of the wax every 10 seconds.

Figure 11 shows how the temperature of the wax varied with time.

Figure 11



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Between 0 seconds and 80 seconds, 4950 J of energy was transferred to the wax.

The mass of the wax was 0.15 kg.

Determine the specific heat capacity of the wax.

Use the Physics Equations Sheet.

[4 marks]

_____

_____

_____

_____

_____

_____

Specific heat capacity = _____ J/kg°C

10

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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